

# Normal Conducting RF

## R&D Program

# RF R&D Outline

- 4 areas of research
  - Cavity processing using SRF techniques
  - Atomic Layer Deposition ALD
  - Magnetic Insulation of Cavities
  - High Pressure RF Cavities
- R&D Plans
- Cost Breakdown
- Time Line

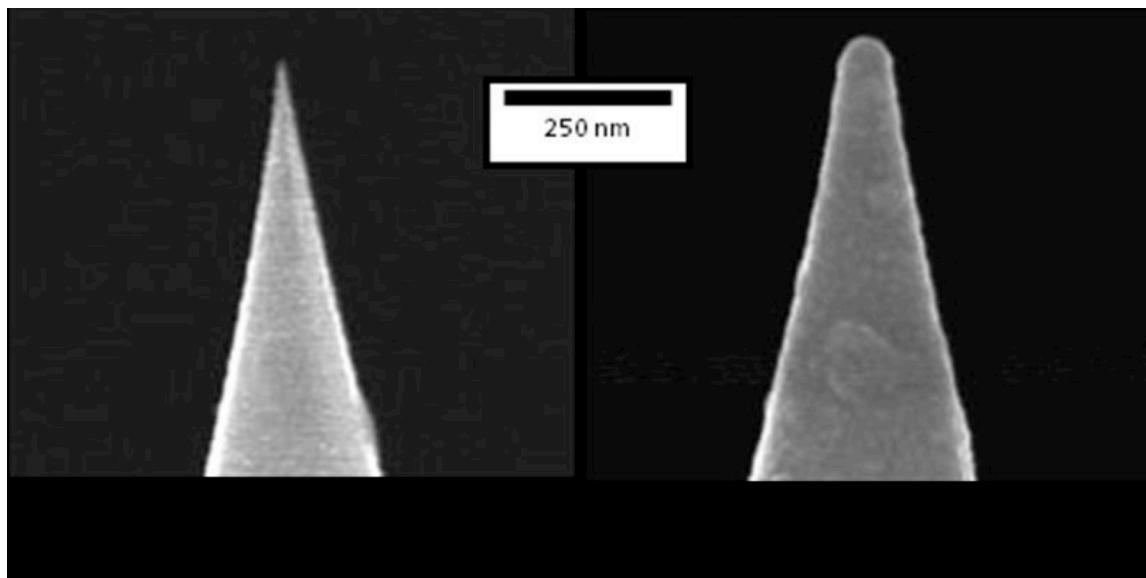
# Cavity Processing with SRF Techniques

- 201 MHz Cavity Fabrication
  - Made from spun copper
  - Electro polished
  - High power rinsing
  - Required minimal processing to achieve gradient



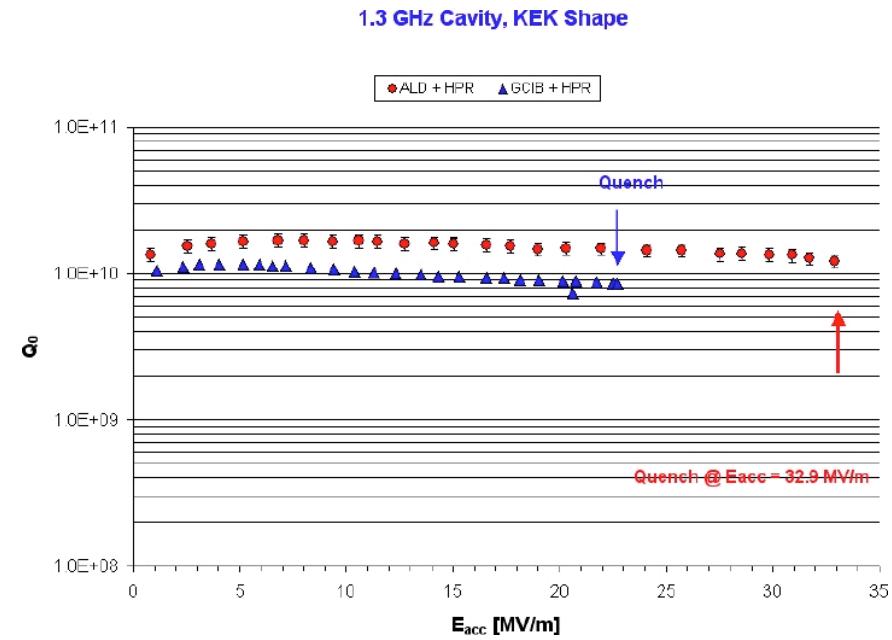
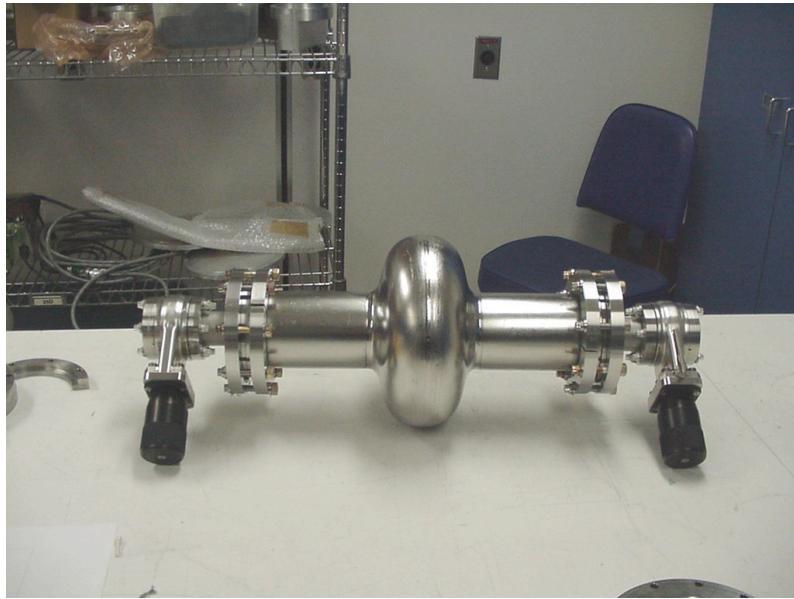
# Cavity Processing with ALD

- Atomic Layer Deposition (ALD)
  - Chemical process
  - Nanometer films of Nb,  $\text{Al}_2\text{O}_3$ ,  $\text{MgB}_2$ , TiN, NbN...
  - Rounds features of asperities reduces arcing
  - Change in work function reduces arcing



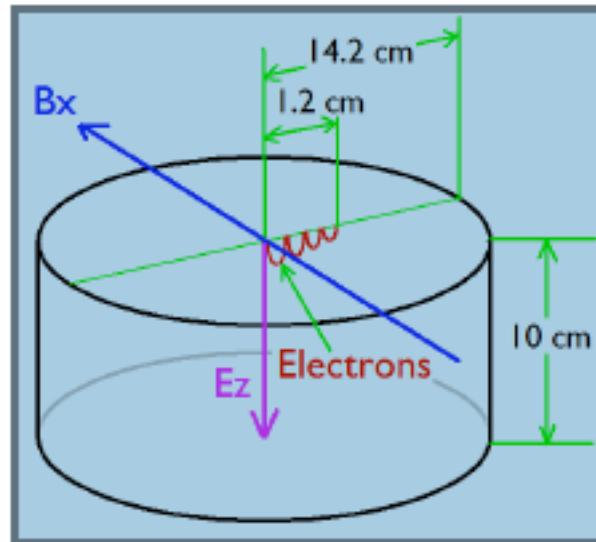
# Cavity Processing with ALD

- Single-cell cavity ALD coated by Jerry Moore, Jim Norem, Mike Pellin, Jeffrey Elam at Argonne
  - Alumina barrier layer plus niobium oxide coating
- Cavity prepared and tested at JLab by Peter Kneisel
  - Result equaled best previous performance with no FE



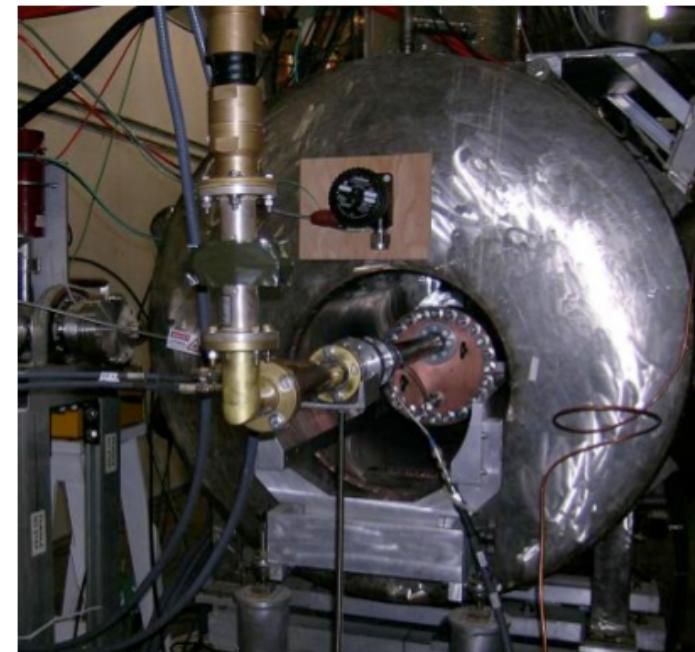
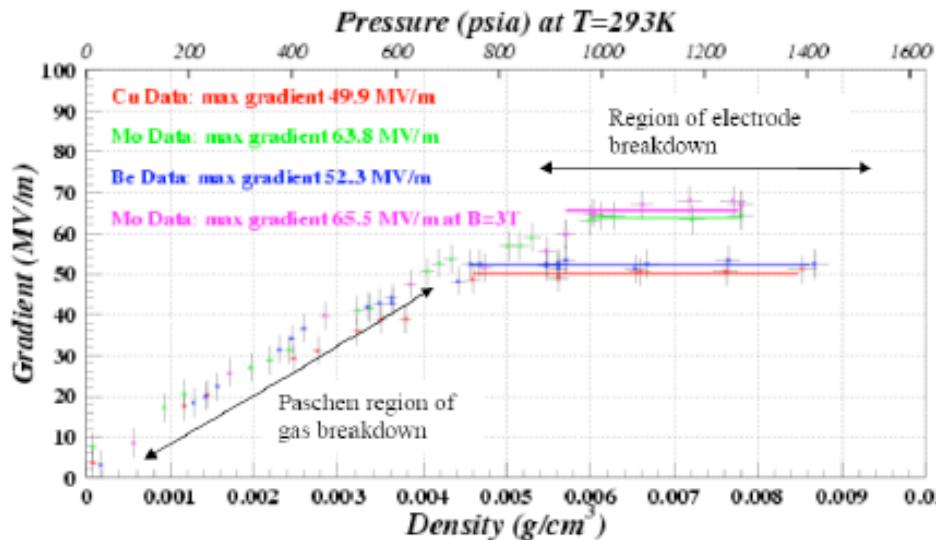
# Magnetic Insulation

- By orienting the cavity to have high gradient surfaces parallel to the magnetic field, emitted electrons are guided to low gradient surfaces, reducing arcing



# High Pressure RF Cavities HPRF

- Cavities pressurized to 100 bar with  $H_2$  reduces arcing
- $H_2$  acts as absorber in cooling channel



# R&D plans

- **Cavity processing**
  - Test 201 MHz cavity immersed in multi Tesla magnetic field
  - If successful, build a 805 MHz cavity modeled after the 201 MHz cavity and test in magnetic field
- **ALD**
  - Test ALD cavity in a magnetic field
  - Test durability of ALD films
  - Build an ALD processed 805 MHz accelerating cavity
- **Magnetic Insulation**
  - Study performance of 805 MHz cavity in various magnetic field alignments
- **HPRF**
  - A beam test of a HPRF cavity in MTA

# Cost Breakdown

## 2.2 COMPONENTS & TESTS: Cooling Channel RF

	FY08	FY09	FY10	FY11	FY12	NOTES
<b>2.2.0 Travel&amp;Workshop</b>						<b>Bross</b>
M&S (K\$)	0	0	0	0	0	
Engineers	0	0	0	0	0	
Techs (FT	0	0	0	0	0	
Post Docs	0	0	0	0	0	
Scientists	0	0	0	0	0	
<b>2.2.1 MTA RF Operations</b>						<b>Bross</b>
M&S (K\$)	90	110	110	110	110	
Engineers	1	0.25	0.25	0.25	0.25	
Techs (FT	1	1	1	1	1	
Post Docs	0	0	0	0	0	
Scientists	0	0.25	0.25	0.25	0.25	
<b>2.2.2 Vacuum RF</b>						<b>Bross/Moretti</b>
M&S (K\$)	90	150	150	75	75	
Engineers	0	1.5	1.5	0.75	0.75	
Techs (FT	0	1.5	1.5	0.25	0.25	
Post Docs	0	0	0	0	0	
Scientists	1.162	0.5	0.5	0.5	0.5	
<b>2.2.3 High Pressure RF</b>						<b>Yonehara</b>
M&S (K\$)	200	20	150	0	0	
Engineers	2	0	1	0	0	
Techs (FT	3.5	0	0.5	0.5	0	
Post Docs	0	0.5	1	0.5	0	
Scientists	1	0.5	1	0.5	0	
<b>2.2.4 Atomic Layer Deposition RF</b>						<b>Norem</b>
M&S (K\$)	0	300	100	100	100	
Engineers	0	1	0	0	0	
Techs (FT	0	0.5	0.5	0	0	
Post Docs	0	1	1	0	0	
Scientists	0	1	1	1	1	
<b>M&amp;S</b>	<b>380</b>	<b>580</b>	<b>510</b>	<b>285</b>	<b>285</b>	
<b>FTE</b>	<b>9.662</b>	<b>9.5</b>	<b>11</b>	<b>5.5</b>	<b>4</b>	
<b>SWF</b>	<b>1530.5</b>	<b>1507.5</b>	<b>1732.5</b>	<b>967.5</b>	<b>742.5</b>	
<b>TOTAL</b>	<b>1910.5</b>	<b>2087.5</b>	<b>2242.5</b>	<b>1252.5</b>	<b>1027.5</b>	

# Time Line

- Cavity processing
  - 2009 cavity fabrication
  - 2010 cavity testing
- ALD
  - 2009 cavity fabrication
  - 2010 cavity testing
- Magnetic Insulation
  - 2009 test setup preparation
  - 2010 cavity testing
- HPRF
  - 2009 cavity testing
  - 2010 cavity modifications

# Participating Institutions

- Cavity processing
  - FNAL
  - ALD
    - ANL
  - Magnetic Insulation
    - BNL, FNAL
  - HPRF
    - FNAL, IIT, Muons Inc.